

## Summary

### Introduction and Background

The Bureau of Reclamation (Reclamation) in cooperation with eastern Oregon stakeholders is studying the potential to improve water supplies in the Burnt River, Powder River, and Pine Creek basins.

### About this Report

This appraisal-level report is prepared in compliance with requirements of the *Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies* (U.S. Water Resources Council, 1983) (P&Gs). It presents a discussion of the formulation of alternatives, a description of the appraisal level designs and cost estimates for the alternatives considered, and the results of the P&G-specific analyses.

Information in this report is based on a variety of studies. Further background information may be obtained from the *Literature Review of the Powder Basin Oregon, Stream Systems, Water Storage, and Stream Health as they Pertain to the Basin and Water Science* (Reclamation 2008). The following website also contains background information: [http://www.usbr.gov/pn/programs/srao\\_misc/storagestudy/index.html](http://www.usbr.gov/pn/programs/srao_misc/storagestudy/index.html)

### Project and Authorized Study Area

Eastern Oregon residents have considered and worked toward developing additional storage opportunities for over 50 years. Water is stored in multiple existing reservoirs, but the stored water does not meet late summer water demand for irrigation and instream water rights for fish habitat. Water diversions to roughly 80 percent of irrigated lands are shut down by late summer, which in turn impact stream health, fisheries, and recreation potential.

In January 2005, the Baker County Board of Commissioners established the Powder Basin Water and Stream Health (WASH) Steering Committee to explore and assess potential opportunities for additional instream and out-of-stream projects. The WASH Initiative's mission is to:

*develop and implement a long-term water management plan that utilizes water conservation, storage and re-use which incorporates beneficial uses such as recreation, agriculture, fish, wildlife, hydropower, flood prevention and instream needs to provide sustainability to the environment, society and the economy.*

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The WASH committee requested assistance from Reclamation’s Snake River Area Office in Boise, Idaho, and secured additional federal funding in 2007 to pursue further assessment of water supply opportunities in the Powder River basin. The purpose of this appraisal study is to:

- Demonstrate an unsatisfied need, either current or future, within the basins
- Determine if water demand in the Powder River basin is unmet (projected to the year 2050)
- Demonstrate whether that need may be satisfied by structural plans for management and development of available resources
- Determine if there is at least one regional alternative to meet current and future demands
- Determine if there is a Federal objective consistent with Reclamation policies, laws, costs, benefits, and environmental impacts in which there exists at least one regional plan that can be recommended to be carried forward into a Feasibility Study

The funding source for this study was directed toward structural solutions for additional storage. As such, this report does not include nonstructural plans for management and development of existing resources, such as automated water delivery control systems. Water conservation options are being examined by the stakeholders in separate but concurrent activities in partial fulfillment of WASH’s stated goals. Preliminary permit applications for consideration of hydropower generation facilities have been tendered by Pacific Rim Energy on Reclamation and other non federal irrigation facilities in Baker County.

The Eastern Oregon Water Storage Appraisal Study area is located in eastern Oregon, bordered to the north by the Wallowa Mountains, to the west by the Blue Mountains, to the south by the Malheur River basin, and to the east by the Snake River. The Burnt River and Powder River water systems are upstream from 10 Snake River and Columbia River dams. The study area is comprised of 3 major basins: Burnt River, Powder River, and Pine Creek, which together encompass approximately 2.7 million acres and are also collectively referred to as the Powder River basin. Stream headwaters originate in the Blue and Wallowa mountain ranges at elevations from 6,000 to nearly 9,000 feet above sea level. They empty into Snake River reservoirs owned and operated by the Idaho Power Company.

### **Appraisal Study Process**

Reclamation’s water resource planning process involves three levels of planning, starting with a preliminary assessment. An appraisal study is a preliminary survey of problems and needs that uses existing information to explore conceptual solutions to identified water resources issues. The appraisal study process includes development and screening of alternatives so only viable alternatives that meet project goals are carried forward into the more extensive feasibility analysis step.

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Reclamation is authorized by the Burnt, Malheur, Owyhee, and Powder River Basin Water Optimization Feasibility Study Act of 2002 (P.L. 107-237, October 11, 2002), to conduct feasibility studies on water optimization in the Burnt River, Malheur River, Owyhee River, and Powder River basins in Oregon.

## Problems and Needs

Irrigation deliveries are the largest water use in the study area. Municipal, domestic, commercial, and industrial uses are estimated to be minimal in comparison.

Approximately one-half of the study area is owned by various Federal agencies. Approximately two-thirds of the area is rangeland, with livestock grazing as the primary land use. One-sixth of the area is forestland where timber harvest and summer livestock grazing are the main uses. Most of the remaining area is cropland and pastureland irrigated by gravity, flood, or sprinkler systems. Irrigated acres produce primarily grain, hay, and pasture (Reclamation 2008; PBWC 1996).

Thirty reservoirs, ranging from 46 acre-feet to 90,500 acre-feet of active storage capacity, supply water primarily for irrigation in the three basins. The hydrology is dominated by snowmelt runoff in the spring, but is also affected by reservoir storage and release. Historic low flows are sometimes less than minimum instream water rights because of low natural runoff or because of upstream diversions by higher priority water rights.

Several basin streams have been identified by the Oregon Department of Environmental Quality (Oregon DEQ 2010) as water quality limited. Pollutants of concern include temperature, sedimentation, chlorophyll, dissolved oxygen, and *E. coli*.

The study area lacks anadromous fish. Portions of the study area are occupied by bull trout, listed in 1998 under the Endangered Species Act as “threatened”, and contain bull trout designated critical habitat. The study area supports a diverse resident fish population and an active recreational fishery which includes both native and introduced species.

A limiting factor in this study was the lack of day-to-day measurements of streamflows, diverted flows, and return flows. Substantial efforts were made to develop and improve methods to understand and evaluate existing basin conditions and potential reservoir sites, including natural flows and irrigation demands.

The total irrigation shortage volume is smaller than the difference between the total flow and irrigation demand for each of the three basins within the study area. However, the location and timing of the flow frequently does not align with the location and timing for the demand. The greatest irrigation demand for water to occurs in July through September, while stream flows are greatest in March through June as a result of the snowmelt and runoff. Water

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supplies are often not available to meet water demands in most of the irrigated areas by mid-to late August, as natural flows recede and stored supplies diminish, resulting in a lack of flow to meet irrigation water rights, instream rights, and needs.

The analysis assumptions relied on available current water use and projected water needs information to develop a 40-year planning horizon through the year 2050 for the study area. Overall water needs are expected to be similar to the current level of demand within the 40-year planning horizon. Available water supply is currently a limiting factor in agricultural applications and is expected to continue to limit agricultural production within the planning horizon. Irrigation shortages for all three basins were estimated to total approximately 161,000 acre-feet.

Current system deficiencies or needs were defined in terms of irrigation shortage and currently filed instream water rights. Anticipated municipal future demands were generated based on a “high-growth scenario” of 2 percent growth per year and an average rate of 115 gallons of water per person per day, projected out to 2050. It is assumed this average municipal rate also includes commercial and industrial needs for the purpose of this study. Based on available information, it was anticipated that existing municipal water rights will meet municipal demand through the 2050 planning horizon.

Conjunctive uses of groundwater and surface water are unknown and, therefore, not included in this level of analysis. While water right information exists for industrial uses, most industrial water rights are currently not being used and demand for industrial water use is not expected to increase for the purposes of this analysis.

Climate change may result in changes to the water supply and demand calculated and used as the basis of this report. No analyses were performed in this study to quantitatively estimate possible changes associated with climate change that might affect reservoir operations, irrigation demand or operations, crop types, cropping dates, environmental flow targets, water supplies and shortages, or hydropower production. A qualitative discussion of impacts may be found in Chapter 2.

## **Resources, Constraints, and Identification of Alternatives**

The literature review process and Reclamation recommended 95 storage sites for hydrologic evaluation with potential economic and ecological benefits. A screening process involving stakeholders was performed that reduced the number of sites for further study, based on good potential for water supply and proximity to need. After site aggregation and further hydrologic analysis, four sites were ultimately selected for an appraisal-level evaluation.

The potential storage sites that were evaluated for this study are the following:

- Hardman Dam and Reservoir site on the Burnt River
- Enlargement of the existing Thief Valley Dam on the Powder River with pumpback; two alternatives were considered but only one carried forward for economic analysis
- North Powder Dam and Reservoir site on the Powder River
- East Pine Dam and Reservoir site on Pine Creek

The proposed Thief Valley reservoir involves enlargement of an existing dam. The other three sites involve new dam and reservoir facilities. Hydropower facilities were evaluated in conjunction with storage. These sites were evaluated individually, not operating in parallel with each other.

## **Alternative Designs and Cost Estimates**

Reclamation completed an appraisal-level evaluation of the four selected sites that included conceptual-level engineering and economic investigations to evaluate site suitability for construction, preparing appraisal-level construction cost estimates, characterizing water supply and hydropower benefits, and identifying permitting constraints and applicable environmental benefits. The team also conducted a qualitative assessment of potential environmental issues and other considerations such as the presence of protected species and their habitats, water quality and recreation impacts, and flood-control potential.

The appraisal-level evaluation of the four potential sites concluded the following:

- Water surpluses are available at each site, and there is need for these storable surpluses.
- Storage facilities could be constructed at each potential site based on field investigations and a review of information.
- Each storage facility has potential for hydroelectric development, although reservoir operations could affect existing hydroelectric projects downstream.
- Each storage facility has potential to improve seasonal streamflows and water temperatures to benefit fish and water quality, depending on ability to store relatively cool water in the spring and release it later in the season when river water temperatures normally rise.

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The study also indicated the following concerns would need to be addressed if any of the projects were to be analyzed in greater detail:

- Each project must address stream habitat needs for fish species that are listed for protection under the federal Endangered Species Act or species of concern. These issues may be resolvable through a variety of actions ranging from installation of fish-passage facilities to habitat mitigation. The East Pine facility is especially sensitive due to the presence of bull trout and designated bull trout critical habitat in the watershed.
- All projects would require either one or several of the following affected by potential inundation by storage water: roadway relocations and mitigation for adverse impacts on parks, utilities, and other existing facilities.
- Some projects would require land purchases, transfers, and/or easements to accommodate reservoir facilities.
- Hydropower potential for each site would require further analysis within the context of its contribution to system wide generation benefits if storage for irrigation is not the primary intended function. The change in timing and quantity of flow to the Snake and Columbia River system, as a result of any alternative, would need to be fully assessed for impacts. These flow changes have the potential to affect the hydropower generation these main stem dams provide to the power grid.
- Flood control, recreation, and other potential benefits were not quantified.

The following table summarizes estimated parameters for the proposed storage reservoir alternatives at their 80 percent reliability levels of water supply. The construction cost is the direct and indirect cost for each proposed storage reservoir. The storable volume, at 80 percent reliability, was used as a threshold of reservoir capacity that would fill in roughly 8 out of 10 years. The estimated average annual irrigation shortage reduction is the amount of average annual additional water supply made available for irrigation by the proposed storage.

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**Summary of Storage Associated with Proposed Storage Reservoirs at 80 Percent Reliability Levels of Water Supply**

No.	Proposed Storage Reservoir	Storage Facility Construction Cost	Storable Volume at 80 percent Reliability (acre-feet)	Estimated Average Annual Irrigation Shortage Reduction (acre-feet)
83	Hardman Reservoir	\$50,000,000	4,800	1,500
30	Thief Valley Reservoir Enlargement with pumping	\$183,000,000	43,000	29,000
40	North Powder Reservoir	\$113,000,000	5,300	4,500
6	East Pine Reservoir	\$133,000,000	21,000	13,700

The following table provides comparisons for construction of hydropower generation and transmission facilities.

**Summary of Hydropower Potential Associated with Proposed Hydropower Facilities at 80 Percent Reliability Levels of Water Supply**

No.	Proposed Hydropower Facilities	Hydropower Plant and Transmission Construction Cost	Generation Potential at 80 percent Storage Reliability (MWh/yr)	Estimated Impacts on Snake and Columbia River system (MWh/yr)	Overall System Change in Generation (MWh/yr)
83	Hardman Reservoir	\$3,100,000	700	(1,100)	(400)
30	Thief Valley Reservoir Enlargement	\$64,000,000	12,400	(22,700)	(10,200)
40	North Powder Reservoir	\$14,700,000	4,900	(2,900)	2,000
6	East Pine Reservoir	\$16,300,000	7,400	(6,600)	800

The Federal objective is to contribute to national economic development (NED) consistent with protecting the Nation's environment. An NED benefit-cost analysis compares the benefits of a proposed project to its costs. Total costs of the project are subtracted from the total benefits to measure net benefits. Benefits associated with the action alternatives are measured as changes from a No Action alternative. If the net benefits are equal to or greater than one, implying that benefits exceed costs, the project could be considered economically justified. Non-quantified parameters, while important, do not factor into the benefit-cost analysis. No other economic analyses were performed for this appraisal level study.

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A benefit-cost analysis was conducted on the proposed alternatives being considered in this study. Benefits and costs associated with each proposed alternative are compared to the No Action (baseline) alternative. Benefit categories evaluated for this analysis include agriculture and hydropower. Other benefit categories such as flood control, recreation, fisheries, etc. were not evaluated. Cost categories include construction of dams, pumping plants and conveyance systems, hydropower plants, power transmission lines and annual operations, maintenance, replacement, and power (OMR&P) costs. Interest during construction (IDC), based on the current FY2011 federal water resource agency planning rate of 4.125 percent, was charged on each construction element annually through the end of the construction period. The construction period was assumed at 3 years for all alternatives (2012-2014). The period of analysis for benefits and OMR&P costs was assumed at 100 years from the end of the construction period (2015-2114).

All benefits and costs are measured in current (2009/2010) dollars. In some cases, costs were initially based on previously developed estimates and therefore had to be indexed to reflect current dollars. In addition, all benefits and costs were converted to a common point in time (when benefits begin to accrue). It was assumed that IDC provides the conversion of construction costs to the end of the construction period. The 100 year stream of agricultural and hydropower benefits and OMR&P costs were discounted (present valued) back to the end of the construction period using the 4.125 percent planning rate.

## Conclusions and Recommendations

None of the alternatives result in positive net benefits or benefit-cost ratios equal to or greater than one.

### Benefit-Cost Analysis Results for each Alternative (Millions \$)

Benefit-Cost Components	Hardman Alternative	Thief Valley Alternative	North Powder Alternative	East Pine Alternative
<b>Total Benefits</b>	<b>42.9</b>	<b>175.3</b>	<b>58.0</b>	<b>37.2</b>
Agriculture	43.6	193.5	54.4	35.7
Hydropower	-0.7	-18.1	3.6	1.5
<b>Total Costs</b>	<b>60.6</b>	<b>280.3</b>	<b>141.2</b>	<b>164.1</b>
Construction & IDC	56.3	262.7	136.1	158.1
OMR&P	4.3	17.6	5.1	6.0
<b>Net Benefits</b>	<b>-17.7</b>	<b>-104.9</b>	<b>-83.2</b>	<b>-126.9</b>
<b>Benefit-Cost Ratio</b>	<b>.71</b>	<b>.63</b>	<b>.41</b>	<b>.23</b>

Following is a brief summary of key points and recommendations for each of the four potential sites analyzed for additional storage, based on this appraisal-level analysis:

***Hardman Reservoir***

Reclamation plans to terminate the feasibility evaluation process for this alternative, as it does not meet the stated Federal objectives for this study. Development and implementation of a long-term plan that emphasizes water conservation and improved management practices is recommended for the purposes of satisfying existing and future water user needs of the basin.

The hydropower generation investigated for this study was secondary to irrigation benefit. The benefit/cost ratio of hydropower generation without consumptive use of stored water for irrigation purposes was not investigated as this was outside the scope of this study. Appraisal level calculations indicate that a storage facility at the proposed Hardman location would have minimal impact on the total annual flow reaching the Snake and Columbia Rivers. However, the impact to the regional hydropower generation systems as a result of the change in flow quantity or flow timing in reaching the Snake and Columbia Rivers was not assessed.

***Thief Valley Reservoir Enlargement***

Reclamation plans to terminate the feasibility evaluation process for this alternative, as it does not meet the stated Federal objectives for this study. Development and implementation of a long-term plan that emphasizes water conservation and improved management practices is recommended for the purposes of satisfying existing and future water user needs of the basin.

The hydropower generation investigated for this study was secondary to irrigation benefit. The benefit/cost ratio of hydropower generation without consumptive use of stored water for irrigation purposes was not investigated as this was outside the scope of this study. Appraisal level calculations indicate that an enlarged facility at the Thief Valley location would have a measurable impact on the total annual flow reaching the Snake and Columbia Rivers. However, the impact to the regional hydropower generation systems as a result of the change in flow quantity or flow timing in reaching the Snake and Columbia Rivers was not assessed.

***North Powder Reservoir***

Reclamation plans to terminate the feasibility evaluation process for this alternative, as it does not meet the stated Federal objectives for this study. Development and implementation of a long-term plan that emphasizes water conservation and improved management practices is recommended for the purposes of satisfying existing and future water user needs of the basin.

The hydropower generation investigated for this study was secondary to irrigation benefit. The benefit/cost ratio of hydropower generation without consumptive use of stored water for irrigation purposes was not investigated as this was outside the scope of this study. Appraisal level calculations indicate that a storage facility at the proposed North Powder location would have minimal impact on the total annual flow reaching the Snake and Columbia Rivers.

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However, the impact to the regional hydropower generation systems as a result of the change in flow quantity or flow timing in reaching the Snake and Columbia Rivers was not assessed.

#### ***East Pine Reservoir***

Reclamation plans to terminate the feasibility evaluation process for this alternative, as it does not meet the stated Federal objectives for this study. Development and implementation of a long-term plan that emphasizes water conservation and improved management practices is recommended for the purposes of satisfying existing and future water user needs of the basin.

The hydropower generation investigated for this study was secondary to irrigation benefit. The benefit/cost ratio of hydropower generation without consumptive use of stored water for irrigation purposes was not investigated as this was outside the scope of this study. Appraisal level calculations indicate that a storage facility at the proposed East Pine location would have minimal impact on the total annual flow reaching the Snake and Columbia Rivers. However, the impact to the regional hydropower generation systems as a result of the change in flow quantity or flow timing in reaching the Snake and Columbia Rivers was not assessed.

The following general recommendations are provided by Reclamation to the project stakeholders as a result of the Eastern Oregon Water Storage Appraisal Study:

- None of the alternatives analyzed as water storage projects for irrigation should be considered for further study.
- Stakeholders should pursue water optimization studies and implementation through grant and loan programs supported by Reclamation and others. Non-structural actions would help irrigators close the gap in water users' water delivery needs. Watershed management or water conservation, such as those identified in the WASH objectives, listed under current activities (Section 1.4) should be pursued.
- Stakeholders could consider further study of projects focused on hydropower generation within the basin.
- To support the above recommendations, stakeholders should pursue means to collect additional long-term hydrologic and water use data within the study area.